THAT WHICH IS CLAIMED IS:

1. A method for forming a capacitor on a substrate, comprising the steps of:

forming a lower electrode on a substrate;

forming a dielectric layer on the lower electrode;

oxygen radical or plasma annealing the dielectric layer; and

forming an upper electrode on the oxygen radical or plasma annealed dielectric layer.

2. The method of claim 1, wherein the steps of forming a dielectric layer and oxygen radical or plasma annealing the dielectric layer are performed in the same chamber.

3. The method of claim 1, wherein the step of oxygen radical annealing the dielectric layer comprises the step of oxygen radical annealing the dielectric layer by exposing the dielectric layer to an atmosphere comprising an oxygen radical.

4. The method of claim 3, wherein the step of oxygen radical annealing the dielectric layer further comprises the step of maintaining the temperature of the dielectric layer equal to or less than 500°C during the exposing step.

5. The method of claim 3, wherein the oxygen radical is ozone.

6. The method of claim 1, wherein the step of oxygen radical or plasma annealing the dielectric layer comprises the step of plasma annealing the dielectric layer by exposing the dielectric layer to an atmosphere comprising a plasma gas selected from the group consisting of O_2, NH_3, Ar, N_2, and N_2O.

7. The method of claim 1, wherein the step of plasma annealing the dielectric layer further comprises the step of maintaining the temperature of the dielectric layer equal to or less than 500°C during the exposing step.

8. The method of claim 1, wherein the steps of forming and oxygen radical or plasma annealing the dielectric layer are performed repeatedly.

9. The method of claim 1, wherein the dielectric layer consists of a material selected from a group consisting of Ta_2O_5, Al_2O_3, TiO_2, Y_2O_3, $SrTiO_3$, $BaTiO_3$, $SrTiO_3$, $PbZrTiO_3$, $SrBi_2Ta_2O_9$, $PbZrO_3$, $LaZrO_3$, $PbTiO_3$, $LaTiO_3$, and $Bi_4Ti_3O_{12}$.

10. The method of claim 1, further comprising the step of oxygen radical or plasma annealing the lower electrode.

11. The method of claim 10, wherein the steps of oxygen radical or plasma annealing the lower electrode, depositing the dielectric layer, and oxygen radical or plasma annealing the dielectric layer are performed in the same chamber.

12. The method of claim 10, wherein the steps of oxygen radical or plasma annealing the lower electrode, forming the dielectric layer, oxygen radical or plasma annealing the dielectric layer, and forming the upper electrode are performed in-situ by one apparatus for forming a thin film.

13. The method of claim 10, further comprising the step of crystallization annealing the dielectric layer after forming the upper electrode.

14. The method of claim 13, wherein the steps of oxygen radical or plasma annealing the lower electrode, forming the dielectric layer, oxygen radical or plasma annealing the lower electrode, forming the dielectric layer, oxygen

radical or plasma annealing the dielectric layer, forming the upper electrode, and crystallization annealing the dielectric layer are performed in-situ by one apparatus for forming a thin film.

15. The method of claim 1, further comprising the step of crystallization annealing the dielectric layer after oxygen radical or plasma annealing the dielectric layer.

16. The method of claim 15, wherein the steps of oxygen radical or plasma annealing the dielectric layer and crystallization annealing the dielectric layer are performed in the same chamber.

17. The method of claim 15, wherein the steps of forming the dielectric layer, oxygen radical or plasma annealing the dielectric layer, crystallization annealing the dielectric layer, and forming the upper electrode are performed in-situ by one apparatus for forming a thin film.

18. A method for forming a capacitor on a substrate, comprising the steps of:

forming a lower electrode on a substrate;
forming a dielectric layer on the lower electrode;
forming a first upper electrode on the dielectric layer; and
oxygen radical annealing the first upper electrode.

19. The method of claim 18, wherein the oxygen radical annealing step comprises exposing the first upper electrode to an atmosphere comprising ozone.

20. The method of claim 19, wherein the oxygen radical annealing step further comprises maintaining the temperature of the first upper electrode at equal to or less than 500°C during the exposing step.

21. The method of claim 18, wherein the dielectric layer comprises a material selected from the group consisting of Ta_2O_5, Al_2O_3, TiO_2, Y_2O_3, $SrTiO_3$, $BaTiO_3$, $SrTiO_3$, $PbZrTiO_3$, $SrBi_2Ta_2O_9$, $PbZrO_3$, $LaZrO_3$, $PbTiO_3$, $LaTiO_3$, and $Bi_4Ti_3O_{12}$.

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22. The method of claim 21, further comprising the step of forming a second upper electrode on the oxygen radical annealed first upper electrode.

23. An apparatus for forming a thin film on a substrate, the apparatus comprising:

a multi-functional chamber configured to deposit a dielectric layer on the substrate; and

an oxygen radical or plasma annealing unit connected to the multi-functional chamber and configured to provide oxygen radical or plasma gas to the multi-functional chamber to oxygen radical or plasma anneal one or more electrode and/or dielectric layers on the substrate in the multi-functional chamber.

24. The apparatus of claim 23, wherein the oxygen radical or plasma annealing unit is an ozone generator or a plasma generator.

25. The apparatus of claim 24, wherein the multi-functional chamber further comprises an ozone remover connected to an exhaust end of the multi-functional chamber.

26. The apparatus of claim 24, wherein the plasma generator is capable of generating a plasma gas selected from the group consisting of O_2, NH_3, Ar, N_2, and N_2O.

27. The apparatus of claim 23, wherein the multi-functional chamber comprises:

a support plate configured to hold the substrate;

a heater unit positioned under the support plate;

a source dispersion device positioned above the support plate and configured to uniformly disperse organic source liquid; and

a source supplier in fluid communication with the source dispersion device.

28. The apparatus of claim 27, wherein the source supplier comprises:

a liquid mass flow controller configured to control a flow of organic source liquid;

an evaporator in fluid communication with the flow controller and configured to evaporate the source liquid; and

a transfer gas source in fluid communication with the evaporator and configured to transfer an organic source from the evaporator to the source dispersion device.

29. The apparatus of claim 28, wherein the source supplier comprises between 1 and 3 evaporators.

30. The apparatus of claim 23, further comprising:

a cleaning gas supplier in fluid communication with the multi-functional chamber and configured to supply cleaning gas to remove dielectric material from a wall of the multi-functional chamber.

31. The apparatus of claim 23, further comprising:

a loadlock chamber configured to introduce the substrate into the apparatus; and

a transfer chamber connected to the loadlock chamber and configured to transfer the substrate from a first chamber to a second chamber, wherein the multi-functional chamber is connected to the transfer chamber.

32. The apparatus according to Claim 31, further comprising an electrode deposition chamber connected to the transfer chamber.

33. The apparatus according to Claim 31, further comprising a crystallization annealing chamber connected to the transfer chamber.

34. The apparatus according to Claim 31, further comprising an oxygen radical or plasma annealing chamber configured to pre-treat a lower electrode and connected to the transfer chamber.

35. The apparatus according to Claim 31, further comprising:
a cooling chamber connected to the transfer chamber; and
a pre-heating chamber connected to the transfer chamber.

36. An apparatus for forming a thin film on a substrate, the apparatus comprising:
a crystallization annealing chamber for processing a substrate; and
an oxygen radical or plasma annealing unit connected to the crystallization annealing chamber and configured to provide oxygen radical or plasma gas to the crystallization annealing chamber to oxygen radical or plasma anneal one or more electrode and/or dielectric layers on the substrate in the crystallization annealing chamber.

37. The apparatus according to Claim 36, wherein the oxygen radical or plasma annealing unit is an ozone generator or a plasma generator.

38. The apparatus according to Claim 36, further comprising:

a loadlock chamber configured to introduce the substrate into the apparatus;

a transfer chamber connected to the loadlock chamber and configured to transfer the substrate from a first chamber to a second chamber;

a dielectric layer deposition chamber connected to the transfer chamber; and

an electrode deposition chamber connected to the transfer chamber;

wherein the crystallization annealing chamber is connected to the transfer chamber.

39. An apparatus for forming a thin film on a substrate, the apparatus comprising:

an oxygen radical or plasma annealing chamber configured to post-treat a dielectric layer and/or an upper electrode; and

an oxygen radical or plasma annealing unit connected to the oxygen radical or plasma annealing chamber configured to post-treat a dielectric layer and/or an upper electrode, the oxygen radical or plasma annealing unit configured to provide oxygen radical or plasma gas to the oxygen radical or plasma annealing chamber to oxygen radical or plasma anneal a dielectric layer and/or an upper electrode on the substrate in the oxygen radical or plasma annealing chamber.

40. The apparatus of Claim 39, wherein the oxygen radical or plasma annealing unit is an ozone generator or a plasma generator.

41. The apparatus of Claim 39, further comprising:

a loadlock chamber configured to introduce the substrate into the apparatus; and

a transfer chamber connected to the loadlock chamber and configured to transfer the substrate from a first chamber;

a dielectric layer deposition chamber connected to the transfer chamber; and

an electrode deposition chamber connected to the transfer chamber;

wherein the oxygen radical or plasma annealing chamber configured to post-treat a dielectric layer and/or an upper electrode is connected to the transfer chamber.

42. The apparatus according to Claim 41, further comprising an oxygen radical or plasma annealing chamber configured to pre-treat a lower electrode and connected to the transfer chamber.

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43. The apparatus according to Claim 41, further comprising a crystallization annealing chamber connected to the transfer chamber.

44. The apparatus according to Claim 41, further comprising:

a cooling chamber connected to the transfer chamber; and

a pre-heating chamber connected to the transfer chamber.

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